RESTORING THE RANGE BY RESEEDING

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FULL RESTORATION of much of the range land in need of improvement will require more than better grazing management. About 80 million acres of range land have been so badly depleted that they will have to be reseeded artificially if they are to recover in our generation. Satisfactory methods have not yet been developed for reseeding all situations, but progress is being made. Already more than 5 million acres have been planted.

Range reseeding is usually done on an extensive basis on lands unsuited for cultivation and at comparatively low cost. Plowing, except to reduce competition from undesirable plants, is usually not attempted; seedbeds are not generally prepared, except for reseeding abandoned cultivated fields in the Southern Great Plains.

On most reseeded ranges, correct grazing management alone is relied upon to maintain forage production, although in much of the South and on annual type ranges of California and in other areas where soils are poor, some fertilization may also be needed.

Reseeding, to be most effective, should be done where the chance of success is good and where increased forage will help most in making better use of the land and in increasing livestock production. For each area to be seeded, success depends on knowing what to seed, when to seed, and how to seed economically.

Practical answers to those questions are available on several important ranges, especially on depleted big sagebrush sites of the Intermountain Region, on abandoned cultivated lands in the plains and foothills, on mountain meadows below good condition in other parts of the West, and more limitedly on the other depleted ranges.

On some other range situations, promising leads have been developed by research, but are only now being tested on a practical scale. On others, research has made only a beginning. Here plantings of only small test areas, until proved procedures are found, will eliminate extensive and costly failures and save seed and effort for more productive planting elsewhere.

Even where specifications are available, sites for reseeding should be chosen with care. Ranges that have enough good forage remnants so that they can be restored rather promptly by better management alone seldom need seeding. Those whose production must always be low because of poor soil or unfavorable climate seldom produce enough forage to pay the cost. Where the valuable forage plants have been largely lost, but the good topsoil retained, the chance for success and the opportunity for improvement consistent with the cost is greatest.

A good appraisal of the site for reseeding may usually be made by observation of the terrain, the existing plant cover, and the soil. In semiarid parts of the West, experienced stockmen often can select the pockets, valleys, or parts of valleys that catch a little more rainfall, have subirrigation, or are subject to beneficial natural flooding. Where the range vegetation (even if composed of inferior forage plants) has a vigorous appearance and good color and makes good height growth and heavy seed crops, the site is apt to be above average.

Dark-colored, friable soil and a covering of humus and vegetable litter usually indicates a favorable site. Thus, where big sagebrush is dense, and the plants large and healthy, good stands of grass can be obtained once the sagebrush is removed. On the Fishlake National Forest in Utah, for example, 500 acres that was supporting a flourishing stand of vigorous big sagebrush and rabbitbrush furnished forage for only 8 or 9 cows for a 4-month season. Three years after it was reseeded to wheatgrasses and bromes at a cost of $3.22

an acre it provided forage for 100 cows for 4 months.

Reseeding will give greatest returns where it can best aid in meeting seasonal shortages in good forage. In most of the Intermountain West, for example, early spring forage is inadequate and sowing crested wheatgrass, an early spring- and fall-growing species, provides valuable grazing at that period.

Even in the Southern Great Plains, where the native grasses are noted for nutritive qualities, forage value drops markedly from early maturity and into winter dormancy. At Woodward, Okla., ranges seeded to western wheatgrass can provide nutritious forage throughout the fall, winter, and early spring. They have supported two to five times more cattle than nearby unseeded range, produced 50 to 80 percent more gain per head, saved 50 to 97 percent of the protein supplements required, and yielded three to eight times as much gain per acre.

In the South and Southeast, reseeding of fire lanes and other portions of piney woods ranges to adapted grasses that retain their protein and mineral content longer than the native species prolongs the period of good grazing, saves supplements, and permits better cattle gains.

Reseeding should be done only where good grazing management can be provided. Reseeded ranges need protection from grazing until the seedlings are established and moderate grazing in the proper season thereafter.

The success and productivity of artificially seeded ranges depends largely on planting species that are adapted to the local climate and that will persist under reasonable grazing use. Probably of first importance on most western ranges is the amount of precipitation and its seasonal distribution.

Less than 8 inches annually, even in the northern part of the western range country, is generally too little to justify the risk of large-scale reseeding. Even with as much as 12 inches annually, a considerable part of it must be available during the growing season, and very drought-resistant plants, like crested wheatgrass or some of the lovegrasses, must be used. Generally where precipitation is more than 15 inches and enough falls during the growing season, a number of forage plants, if soils and other conditions are satisfactory, are adapted.

Grasses withstand dry periods best when dormant. Hence it is necessary in each region to plant those that normally make their growth during the season when moisture is available. Where soil moisture is available in the cool spring and fall seasons, as in the valleys, foothills, and mesas of the Intermountain West, the wheatgrasses, bluegrasses, bromes, fescues, and other cool-season grasses can be used. Where summer rainfall is the rule, as in the Southwest, warm-season plants—native gramas, buffalograss, and the introduced lovegrasses—are best.

Low winter temperatures may limit the species that can be planted successfully. In the northern range country, only hardy native species (like slender and western wheatgrass, and mountain brome) or hardy introductions from comparable latitudes (like crested wheatgrass and Russian wild-rye from Siberia or smooth brome from Hungary) can survive.

In the Southern Great Plains and the Southwest, besides such natives as blue grama and side-oats grama, buffalograss, and sand lovegrass, three introduced lovegrasses from South Africa are promising. Of these, weeping lovegrass is the most cold-resistant, succeeding in northern Oklahoma and northern New Mexico. Boer lovegrass has less cold resistance, and Lehmann's least of the three. Since, however, both of these are more drought-resistant than weeping lovegrass, both cold resistance and drought resistance influence the selection for any specific area.

In the deep South moderate winter temperatures permit the use of such semitropical grasses as Bermuda, Bahia, and Dallisgrass, and among the legumes, the lespedezas, and crimson

and white clovers. Each of these has its own cold tolerance which strictly limits its use. Cold-resistant strains of some are being developed by selection and breeding. Plants for reseeding in the piney woods also need the ability to grow in shade, under partial covering of fallen pine needles, and to withstand burning and competition from vigorous native grasses of lower value.

Mixtures of a few adapted species with similar palatabilities and seasons of growth usually take best advantage of differences in site conditions which may change frequently and sharply between parts of any large area. A single species may be largely eliminated by disease, pests, extreme drought, or winterkilling. In such instances, if several species are used together some will likely be much less affected than others and will fill in and maintain production of the stand. Mixtures also generally increase the nutritive value of the forage. Where the legumes are adapted, one or two should be included to add variety to the forage and add to soil nitrogen.

However, pure stands of species that differ in their season of usefulness and palatability, and so require different management, are often better than mixtures. Where both the cool-weather and the warm-weather grasses are adapted, separate seedings can be grazed when each is most nutritious. Each class can be managed according to its needs. Neither competes to the disadvantage of the other. Highly palatable species that cannot withstand heavy grazing, like sand lovegrass in the Southern Great Plains, can be maintained only if sown in pure stands or with other palatable species. Comparatively unpalatable but productive and nutritious grasses—such as many of the wheatgrasses—are best sown in pure stands or with species of similar palatability, and then grazed heavily enough to utilize them and maintain their succulence.

Source of seed is extremely important in successful establishment, productivity, and persistence of reseeded stands, especially for native species. Locally grown seed from plants that have proved their adaptability is preferred. Slender wheatgrass seed harvested in the Northern Great Plains, for example, is well suited for planting there, but in Utah produces small plants with little forage and no seed.

In the Plains it has been found that forage yield and length of growing period are greatly increased by using southern sources of seed. It is advisable there to use, at any given latitude, seed harvested south of that latitude. Seed may be used several hundred miles north of its source without much danger of winterkilling. Blue grama seed from northern Oklahoma, for example, has survived the winters in southern Alberta and produced several times the forage yield of Alberta blue grama.

In contrast with this, seed of most native grasses, when planted south of their source, produce plants decidedly lacking in vigor, production, and period of growth. Colorado and Kansas sources of blue grama and buffalograss, for example, produce in Oklahoma and Texas much less than half as much forage as plants from local seed.

Not only adapted species, but also adapted strains, must be chosen to give best results. Recent research has indicated immense possibilities for improving range grasses through genetics and selection. Some selections of smooth brome, for example, yielded under range conditions in central Utah five times as much forage as other tried strains. Differences in such important characteristics as leafiness, earliness or lateness of growth, seed production, ease of harvest, resistance to drought, cold, and disease have been found among selections of the grasses so far studied. Indications are that use of better strains can at least double forage production, make stand establishment more positive, and extend the usefulness of many species.

But proper choice of strains depends on careful consideration for each site. The most productive strain of moun-

tain brome in the oak-brush zone of Utah, for instance, is entirely worthless in the next higher zone, where it winterkills.

How to Reseed

Growing conditions on most range land are difficult at best. Germinating seeds and young seedlings require a reliable and constant source of moisture. Range soils dry so rapidly on the surface that seed usually must be covered to provide adequate moisture as well as necessary anchorage for the growing seedling.

Correct depth of planting is also important. Until the young leaves have emerged from the soil and can build food, growth of the seedling depends on the food stored within the seed. Since this is limited, seeds planted too deeply cannot emerge and produce satisfactory stands. Generally seeds should be covered only enough to insure that they are kept moist until the roots can reach soil with a dependable supply of water. Satisfactory plantings of all species used in range reseeding have been obtained with covering of from ½ to 1 inch. Planting may be somewhat deeper for large seeds than for small, for light soils than for heavy, and for localities with light infrequent showers than where rainfall is more dependable.

Broadcasting seed with little or no provision for covering is of limited usefulness. It is most likely to succeed where rainfall is rather ample and dependable and where the small-seeded grasses like bulbous bluegrass, dropseeds, and lovegrasses can be used. Broadcasting on recently burned brush or timber ranges, if done before the ashes have settled or blown or washed away, can be effective. The seed will be covered by the loose ashes. Fallen leaves from aspen and possibly some other kinds of deciduous trees will give satisfactory covering of seed broadcast at about the time of leaf fall.

Airplanes provide an inexpensive means of broadcasting in some districts. An accidental burn in young Douglas-fir-ponderosa pine on the Cabinet National Forest in Montana was seeded by airplane in the fall of 1944. Total cost was only $1.20 an acre. Two years later, the timothy, orchardgrass, Kentucky bluegrass, and bulbous bluegrass had fully protected the soil and were producing a ton of green herbage an acre. Obtaining uniform distribution of seed and flying accurately and safely are major problems over rough, mountainous range lands at elevations near the ceiling of the plane.

Airplane broadcasting of seed contained in soil pellets seems to offer advantages in facilitating uniform distribution of seed over large areas and increasing chances for success without covering. Further testing of this method is justified.

For planting at a uniform controlled depth, grain drills of either the single-disk, double-disk, or deep-furrow type are most useful. Flanges on the disks to control depth of planting, the addition of heavy press wheels to firm loose soil behind the disks, and strengthening and reenforcement to enable them to stand up in the rocky soils, thick brush, or rough terrain of range lands are desirable. Shallow plowing or heavy disking can be used to cover broadcasted seed, but since depth of covering with this method is somewhat haphazard, heavier rates of seeding than with drilling are necessary.

Perennial grass seedlings develop more slowly than most annuals and cannot compete for moisture, light, and space with annuals or established perennials whose period of growth coincides with their own. Reduction of this competing vegetation is difficult and costly, but essential to success. Complete removal, however, such as by burning or the preparation of a clean seedbed, may be undesirable because of drying and erosion of the soil and damage to the seedlings by wind, sand blasting, rodents, or frost heaving. Annual weeds which make most of their growth after seeded species are well started, such as Russian-thistles and

tumblemustard in the Intermountain region and northern Plains, need not be removed. They are frequently beneficial in protecting seedlings.

One economical and effective method of reducing competition of many nonsprouting brush species, notably big sagebrush, is by prescribed or planned burning, when the conditions are suitable in the fall. Cheatgrass brome, an annual grass, can also be effectively reduced if it is burned just prior to the falling of the seeds. On many southern ranges in the longleaf pine type of the Coastal Plain, prescribed burning in winter is necessary to remove the "rough" and allow the seed to get to mineral soil. Burning is not recommended where desirable tree reproduction might be damaged or for brushy species which sprout vigorously, such as California chaparral. It is also a poor method on hot sandy ranges that are subjected to high winds and rapid surface evaporation.

Fire must be employed with care. It should be used only on range types where its value has been demonstrated, and in such a manner and where it will not jeopardize timber, watershed, or other values. Before burning, one must make sure that adequate fire lines have been made, and that ample help is on hand to take care of any emergencies. The topography should be sufficiently level that there will be no serious danger from erosion. Depleted ranges require seeding as soon as is feasible after burning to stabilize the soil and prevent reinfestation by undesirable plants.

Heavy one-way disk or wheatland plows are perhaps the most adaptable and effective machines for eliminating competition by many brush and weed species. The brush is left on the land, and the land is left rough so that it is not subject to severe erosion. As much as 80 to 95 percent of the competition can be eliminated by shallow wheatland plowing. Seeder attachments are available, so if work is done at the proper season, planting can be accomplished at the same time. The method is limited, however, to land with moderate slopes and little or no rock. A new-type plow with disks mounted on springs to reduce breakage even on rocky areas is especially promising.

Recently developed oversized and self-clearing harrows and rail drags with improved cutting edges are effective for eliminating undesirable plants where the one-way disk plow cannot be used because of rocky soil or broken topography.

The stubble-mulch method of land preparation has been effective in reseeding abandoned cultivated lands in the Southern Great Plains and subhumid areas east of the Plains. A close-drilled sorghum crop is grown on the land the first year. It is planted late enough in the season—in late June or July—so that the crop will not mature seed, volunteer the second year, and offer competition to perennial grass seedlings. Part of the standing sorghum crop is grazed off in the fall in order to pack the soil and realize some income. Sufficient stubble cover must be left by the livestock to control wind and water erosion, reduce surface evaporation, and prevent soil crusting. Grasses are drilled directly in the stubble the following spring. If the soil is still somewhat soft, a heavily weighted roller is run over the land. Rolling firms the soil around the seed, reducing moisture losses, and is often valuable wherever the soil is too loose.

When to Reseed

Reseeding should be done when seedlings will have the longest possible period of good growing conditions for establishment.

Planting should be timed so that seeds can germinate as soon as this favorable growing period begins. Seedling growth may be curtailed by low temperature, dry weather, or competition from weeds or other vegetation. In the intermountain valleys and foothills of much of the West, soil is usually moist during the winter and spring, but a summer dry period is the rule and seedlings must be big enough by

early summer to withstand 100 days or more without effective rain. Fall planting, therefore, which gets the seed in the ground, ready to germinate with the first warm day of spring, is generally best for cold-resistant grasses. Where frost damage is severe, however, as on ranges with little vegetation or litter cover, and especially for susceptible legumes, early spring planting may be necessary.

Planting in the early summer is most successful in the Southwest, where the spring months usually are dry but good summer rains prevail. Where rainfall is rather well distributed during the growing season, as in the Great Plains, cool-weather grasses may best be sown in the fall, and warm-weather grasses at the beginning of the growing season in the spring. The exact date depends on the local precipitation pattern, the species used, the method of planting, and the time of weedy growth. Delayed seedings on abandoned plowed land in the Southern Great Plains meet with weed competition. Seedings, however, may be delayed in that area, where wind erosion is not important, until one or two crops of weed seedlings have been destroyed by surface tillage.

The growth requirements of the plant and the nature of the seed also affect the choice of planting season. Thus cool-season grasses, such as the wheatgrasses, can be seeded more readily in fall than warm-weather grasses such as the lovegrasses, which are killed by freezes, or legumes whose smooth taproots make them susceptible to frost heaving. Some seeds with hard coats, such as sand lovegrass, sand paspalum, and buffalograss, and others, such as fourwing saltbush and antelope bitterbrush, that need an after-ripening treatment, germinate better after freezing temperature. They should be sown in fall or very early spring.

During their first year, grasses used for range reseeding may make but little growth. Reseeded ranges do not develop so rapidly as cultivated pastures. Some range grass seedlings may show only a few small brown leaves in their first dry season and be almost invisible until they resume growth the next year. Because of this, plantings should not be plowed up or reseeded until they have had time—at least 2 or 3 years—to demonstrate success.

Reseeded ranges need protection from grazing until the seedlings are large enough to withstand pulling or trampling by livestock. This may require from 1 to 3 years, depending on the weather and other growing conditions. The plants are big enough to withstand grazing, however, when the first seed crop is produced, so that the best rule is to keep livestock off newly seeded ranges until seed heads show, whether that be at the end of the first growing season or after several years.

To assure maintenance of production from the reseeded stands, careful grazing management is needed. Principles of management described for native ranges provide valuable guides and should be used as a basis for grazing reseeded ranges. In addition, it is wise to keep a careful and frequent watch for any lowered vigor of the reseeded grasses—e. g., reduced height growth, small seed crops, poor color, and death of parts of clumps—and for invasion by low-value plants. If these signs are observed, livestock numbers will need to be reduced or the season of grazing shortened.

If wisely used, reseeded ranges will support more livestock for longer periods and in better condition than comparable unseeded ranges. Their production compares favorably with native ranges in good or excellent condition on similar sites and is far above that of ranges in poor, very poor, or even fair condition. The increased forage can be maintained indefinitely. Several experimental seedings on the Manti National Forest in central Utah have been grazed each year since they were planted in 1912. Many extensive plantings in other parts of the West have been grazed for 10 to 15 years and still produce from 2 or 3 times to as

much as 20 times more forage than before seeding.

Total costs of reseeding, including seed, planting, supervision, and incidental items, range from $1.50 to $10 an acre, depending on the species and methods used. Most reseeding has been done for less than $5 an acre. The direct value of increased forage provided by reseeding varies from 15 to 50 cents an acre per year. In addition, many indirect values, such as soil and watershed protection, better balance of the year's forage supply, and more efficient livestock production, are realized. With such relationships between costs and benefits, very satisfactory financial returns on money invested are realized from seeding of carefully selected ranges to adapted species and providing proper grazing management.

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GUARD FIRST THE BOTTOM LAND

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OFTEN the heart of a ranch is its flood-watered bottom land. These acres of alluvial plains may comprise only one one-hundredth of the area of the ranch, but if they are in good condition they can produce 2 to 20 times more forage than do the adjacent uplands.

The flood plains often have significant value as a nursery for calving or lambing, a hospital for thin or ailing stock, a fattening pasture, a winter-feed pasture, or a hay meadow. On them the carry-over of soil moisture after flooding may insure green forage for months after the upland range has dried up.

Where only light runoff is available, grasses in the flood-irrigated valleys may be the same species found on the uplands although more luxuriant. The most significant increase in production, however, occurs when the volume of floodwater is great enough that the short grasses are replaced by taller, deeper-rooted species. Forage production then may be measured in tons as forage from the uplands is measured in hundredweights.

That is what happens when the range is in virgin state or in good condition. But often it is not: Depletion has been severe in many places. Upland vegetation has deteriorated. Much of the original grass cover has disappeared. The shrubs and grasses which follow are less able to resist erosion, and flash runoff increases.

And on the bottoms and flood plains misuse has been most concentrated: Cattle congregated on them; roads and trails appeared; the vegetation was thinned out; and channels were cut. When these areas were in virgin condition, heavy floods dug out pot holes, which usually filled with silt and debris and were revegetated without permanent damage. But as the vegetative cover was depleted, the holes grew in length and gullies were formed, made worse by the ruts and channels in the roads and trails. The bottoms were